

# Mechano-Adaptive Polymer Materials – Training and Learning

**Key words: Hydrogels, Mechanical Properties, Embodied Intelligence, Training, Adaptation**

We are searching for a PhD Researcher to join our team on the research line of Mechano-Adaptive Polymer Materials.

True adaptation refers to training (like muscles that self-strengthen), sensitization (learning to respond to a signal when being exposed to it repeatedly), habituation (learning to ignore a signal), and associative learning (like the Pawlow dog). Incorporating such features into polymeric materials is a profound scientific challenge, and would open up avenues to making materials adapt to new situations and for self-increasing their performance. It requires to build an interface from the polymeric material to simple chemical information-processing circuits. We have recently shown how chemical reaction networks can control materials and how mechanical activation in hydrogels can be coupled to chemical reaction networks to self-destruct.

**In this ERC project**, we are particularly interested in making polymer hydrogel materials that can self-strengthen or adapt by habituation and sensitization. This involves the design of precision-engineering chemical functionalities within hydrogel networks that can be activated by mechanical actuation and which can trigger chemical reactions that ultimately change feedback into the mechanical state of the material. The project unites organic synthesis, polymer chemistry and adaptive material design.

You will have the opportunity to develop your project independently based on a diversity of interesting and engaging research questions, and analyze the systems with a diversity of suitable methods (spectroscopy, mechanical tests, mechanofluorescence measurements, microscopy, ...).

## **We offer:**

- a highly engaging and current research topic in an excellently equipped lab infrastructure
- an inspiring environment in an international and ambitious team
- a multidisciplinary lab environment with ample opportunities to develop beyond your core project
- a stimulating local research environment with excellent collaboration possibilities
- support for personal development with attendance to conferences, workshops and soft skill seminars
- excellent and close support of PhD researchers
- possibilities for national and international collaboration

Prof. Walther (h-index 72, age 42) is a Gutenberg Research Professor, a Max Planck Fellow and a 2 x ERC Awardee. More information on the group can be found here: [www.walther-group.com](http://www.walther-group.com)

## **EXPECTED CANDIDATE PROFILE**

- highly motivated candidate with a very good degree in Chemistry or related disciplines
- independent and self-responsible work ethic
- Enthusiasm for basic research, creative experimental approaches, and scientific networking
- Excellent English skills and enjoyment of teamwork
- Background in polymer science, supramolecular chemistry, soft matter. Good skills in organic chemistry are required. Previous exposure to hydrogels, mechanical testing, mechanoresponsive materials are a plus.

## **4 Selected references on DNA-based artificial cells in the past:**

1. **A. Walther** “From Responsive to Adaptive and Interactive Materials and Materials Systems: A Roadmap” *Adv. Mater.* 1905111 (2020) (Invited View Point).
2. C. Lupfer, S. Seitel, O. Skarsetz, A. Walther “Mechano-Activated Self-Immolation of Hydrogels via Signal Amplification” *Angew. Chem. Int. Ed.* 62, e2023092 (2023).
3. G. Fusi, D. Del Giudice, O. Skarsetz, S. DiStefano, **A. Walther** “Autonomous Soft Robots Empowered by Chemical Reaction Networks” *Adv. Mater.* 2209870 (2022).

4. R. Merindol, G. Delechiave, L. Heinen, L. H. Catalani, **A. Walther** “Modular Design of Programmable Mechanofluorescent DNA Hydrogels” *Nature Commun.* 10, 529 (2019).

**The position is according to the German salary scale (TVL 13/2 65%) with full social benefits. The position is available from Fall Spring/Summer 2024 and has a duration of 3 years. Starting date is flexible.**

**Application Deadline is April 15<sup>th</sup> 2024.**

Please send your full application as a **single** PDF file containing

- letter of motivation including a summary of your past research experience and research interests.
- A meaningful summary of your Master thesis
- Transcript of records of your Master and Bachelor program.
- curriculum vitae and list of publications
- One, or if possible, two contacts for reference letters

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